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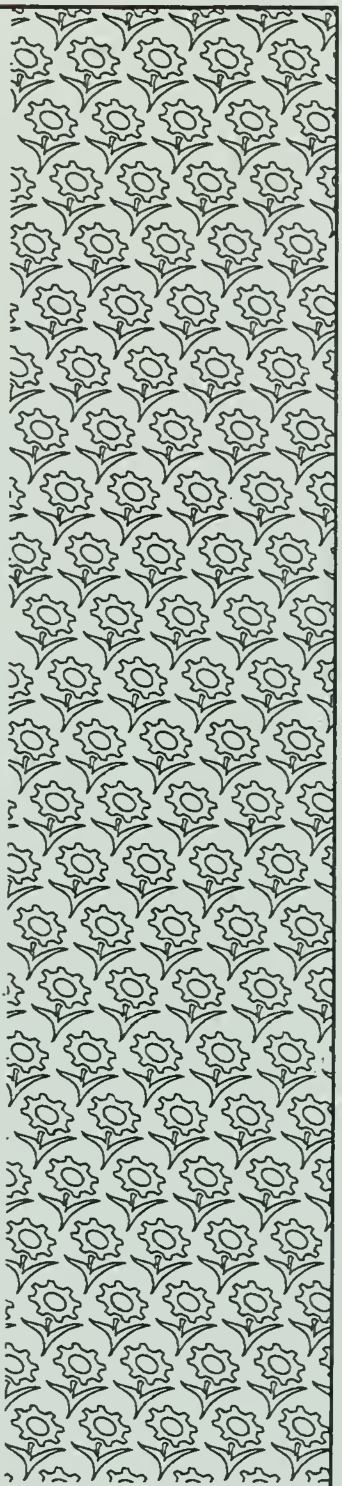
Ontario

Economic Assessment

Ontario Environmental Remediation Sector

March 1997



ONTARIO'S GREEN INDUSTRY

ECONOMIC ASSESSMENT

ONTARIO ENVIRONMENTAL REMEDIATION SECTOR

March 1997

Ministry of Environment and Energy
Ministry of Economic Development, Trade & Tourism

ONTARIO'S ENVIRONMENTAL INDUSTRY SECTOR

Ontario currently has more than 2,000 companies that constitute its environmental industry. Ontario's environmental industry companies have developed leading-edge technologies to provide solutions to problems involving the use of air, land, water and energy.

Companies in Ontario's environment industry offer products, processes and services which prevent pollution, protect or clean up the environment. Companies in this sector offer expertise in the areas of:

- ☼ Water and wastewater treatment/water conservation
- ☼ Solid and hazardous waste/recycling
- ☼ Site remediation and reclamation
- ☼ Energy conservation/renewables
- ☼ Air pollution control
- ☼ Monitoring/instrumentation/labs

The Ministry of Environment and Energy supports the environment industry sector through its Green Industry Office (GIO), whose mandate is to promote the growth of domestic and international markets for Ontario environmental companies. The GIO assists the sector in three main areas: technology development, business development and trade promotion. The GIO also provides comprehensive information on the sector. As part of its ongoing initiative to provide intelligence on the environment industry sector and its components, the GIO commissioned the Ministry of Economic Development, Trade and Tourism to prepare a report which identifies and assesses the Ontario environmental remediation industry's strengths, weaknesses, opportunities and threats. Its goals are to increase awareness that there is a strong site remediation industry in Ontario, and help to stimulate the expansion of business opportunities for these companies.

This report complements the Guideline for Use at Contaminated Sites in Ontario released in June 1996 by highlighting the capabilities of Ontario's environmental remediation sector which provides the solutions to help meet these guidelines.

We welcome your feedback on the report, and invite you to complete and return the **Reader Response Form** which you will find on the last page of this document.

ACKNOWLEDGEMENT

This project was directed by a sector advisory committee comprised of the following members:

- James Beechinor, Agra Earth and Environmental
- Nora Gurland, Ministry of Environment and Energy, Green Industry Office
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The Ministry of Environment and Energy and the Ministry of Economic Development, Trade and Tourism wish to thank the members of the advisory committee who provided information and advice on this project. This report would not have been possible without their essential contributions.

DISCLAIMER

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The Ministry of Environment and Energy and the Ministry of Economic Development, Trade and Tourism do not assure or guarantee the accuracy or completeness of the information contained in this report.

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EXECUTIVE SUMMARY

I. Background

This report, commissioned by the Ministry of Environment and Energy (MOEE), identifies and assesses the Ontario environmental remediation industry's strengths, weaknesses, opportunities and threats (SWOTs). Undertaken in collaboration with industry stakeholders, this work is part of a number of activities to support the implementation of a strategy for Ontario's environmental industry sector.

The project was directed by a sector advisory committee comprising members from industry, Environment Canada, MOEE and the Ministry of Economic Development, Trade and Tourism (MEDTT). Given its role in sector development and experience in undertaking industry economic analyses, MEDTT was commissioned to prepare this report.

A brief summary of the report's highlights and key findings follows.

II. Industry Description

- The environmental remediation industry undertakes a range of interrelated services that are employed to achieve a common goal: the clean-up of contaminated soil, water, sediments and groundwater [section 1.1]. The process of environmental remediation involves the use of physical, chemical or biological processes to destroy or reduce the volume, toxicity and mobility of contaminants in soil and groundwater [section 1.1].

- Large firms, participating in this market, tend to be highly diversified, undertaking remediation only as a sideline activity. Small firms, on the other hand, generally focus on the provision of niche remediation services.

- The industry's major stakeholder groups include remediation firms, customers (primarily developers, manufacturers and large natural resources companies), lenders and government.

III. Remediation Market

- Remediation firms operate in a market that is predominantly driven by real estate transfer and, as part of this process, by customers' desire to reduce exposure to future liability for the potentially hazardous effects of site contamination [section 3].

- Domestic remediation firms face little import competition. The domestic market, however, is highly competitive and, consequently, profit margins are low [section 2.1].

IV. SWOT Analysis

__Strengths__ [Chapter 2]

- **"Home-based"** industry - i.e., most firms are domestically-owned and operated; hence, there are no corporate barriers to exploiting export opportunities or to developing proprietary technology.

- **High export-orientation** among large firms.

- **Highly skilled workforce** with no shortage of skilled labour.

- **Strong industry linkages** - firms have access to a full range of suppliers and have strong strategic relationships with foreign partners.

- **R&D intensive** - most companies own proprietary technology and it is estimated that, on average, firms invest 6% of their revenues in R&D.

- **Solid industry infrastructure** - firms have access to industry associations and universities/research organizations (e.g., firms identified links with universities and Centres of Excellence, notably the Waterloo Centre for Groundwater Research, as important to their competitiveness).

__Weaknesses__ [Chapter 2]

- **Low export-orientation** among small firms - a large proportion of the industry's firms are small and lack the critical mass to exploit export opportunities.

- **Low profit margins.**

__Opportunities__

- **Export opportunities** - The U.S. and Eastern Europe have large markets for remediation services. [Chapter 5]

- **Government programs and R&D tax credits** are useful to the industry, helping it to develop new technologies. [Chapters 3 and 4]

- **Contamination of urban lands** - Currently, many large industrial facilities containing various degrees of contamination are located on prime urban lands. This is an opportunity for industry growth (Benazon, 1995). [Chapter 6]

- **Remediation construction** - As the U.S. market shifts from remedial investigation to site clean-up, opportunities will emerge for firms with remediation construction capabilities. [Chapter 5]

- **Niche clean-up technologies** - An opportunity exists for firms to develop and apply technologies for the clean-up of contaminants that cannot be dumped in landfills. [Chapter 4]

- **Increasing demand for business-oriented services** - Major corporations are recognizing the benefits that accrue from pollution abatement and clean-up. Consequently, they require the services of consultants to advise them regarding the strategic use of corporate resources to address waste reduction and remediation. [Chapter 3]

- **Increasing demand for project management services** - Firms with this capability will gain a competitive edge, as demand for this type of service is growing. [Chapter 5]

Threats [Chapter 4]

- **Real estate conditions** - demand for real estate transfer affects growth in the remediation market.

- **Declining landfill costs** favour landfill disposal relative to the use of remediation technologies.

V. Outlook/Conclusions

- Firms possess many of the fundamental elements of competitiveness: home-based, R&D intensive, strong linkages and highly skilled workforce. Hence, Ontario's remediation firms, in general, possess attributes that position them to compete in export markets and, accordingly, generate industry growth.

- The domestic market for the industry's services is affected by the rate of economic growth. Uncertainty should be diminished now that MOEE has released a new set of site clean-up guidelines. This by itself will not stimulate demand for remediation services, which ultimately depends on economic growth (i.e., growth in gross domestic product, which stimulates real estate transfers).

- Land development is influenced by three main factors: the extent to which manufacturers are operating at capacity; the demand for residential construction; and the availability of commercial real estate.

- Industry growth is affected by landfill costs which favours landfill disposal as a remediation option relative to remediation technologies.

- Given the constraints on growth in the domestic market, it is clear that export growth is crucial to the future prosperity of this industry.

- The U.S. market presents an opportunity for Ontario firms to export their services. However, Ontario exporters will have to compete with U.S. firms in a highly competitive market.

VI. Implications for Stakeholders (Challenges)

Remediation Firms

- Remediation firms must develop export strategies, including strategic partnerships which are especially important for small firms that lack critical mass.

- Slow markets and low profit margins are likely to force consolidation within the industry, especially in the case of small firms. This is likely to be exacerbated by the fact that demand for project management services and turnkey services is increasing; small firms do not tend to have these capabilities, as do their larger counterparts.

- Competitiveness is hampered by conditions favouring landfill disposal which reduces the feasibility of undertaking R&D activity.

Customers

- Due to the fact that the market is both slow and highly competitive, customers are in a favourable position, as prices are driven down.

INTRODUCTION

Background

The Ministry of Environment and Energy (MOEE), in accordance with its mandate for the development of Ontario's environmental sector, is working in collaboration with stakeholders in the Ontario environmental remediation industry to produce and implement strategies and initiatives to foster the industry's growth potential. As a precursor to undertaking this work, MOEE requires a base of information concerning the sector's strengths, weaknesses, opportunities and threats (SWOTs). Accordingly, the ministry commissioned the "sector economic assessment" that follows.

A "sector economic assessment" comprises: 1) an examination of a sector's structural strengths and weaknesses - i.e., factors internal to an industry; 2) an assessment of the opportunities and threats that a sector faces - i.e., factors external to an industry; and 3) conclusions regarding an industry's economic outlook.

The sector economic assessment begins with a description of the sector's services and technologies (Chapter 1), setting the stage for the discussion of the industry's SWOTs. The second chapter, "Industry Structure," examines the industry's internal strengths and weaknesses - e.g., workforce skill levels, export-orientation, linkages, networks, etc. The purpose of this assessment is to determine the industry's ability to exploit opportunities for market penetration, domestic and international.

The third chapter, "Business Climate," identifies and examines the factors of demand for the industry's services - i.e., conditions that create a market for remediation services. The status of these factors of demand and their impact on the domestic remediation industry is assessed, in conjunction with a range of industry issues, in chapters four and six.

Chapter four covers issues that have an impact on the industry's internal strengths and weakness and its external opportunities and threats. Issues reported here are those that were identified by industry stakeholders, interviewed in connection with this undertaking. The identification and assessment of these issues is provided as a complement to the preceding assessment of the industry's SWOTs - i.e., stakeholder's views are essential for either corroborating or qualifying SWOTs, which were largely determined on the basis of a literature review and an industry survey.

Chapter five, "Industry Performance," examines trends in the industry's economic activity. This is undertaken with a view to determining whether the industry is performing as one would expect, given its SWOTs identified in the previous chapters of the report.

Chapter six summarizes the industry's SWOTs, draws conclusions regarding its economic outlook and outlines the implications of the industry's outlook for sector stakeholders.

Objectives

The specific objectives of this undertaking are to:

- identify barriers preventing Ontario firms from exploiting opportunities in the domestic and international remediation market;
- provide information that can be used to market the industry's strengths and investment opportunities to the financial market;
- provide information that supports the international marketing of the industry; and
- develop a base of information that can be used to enhance the competitiveness of the sector.

Scope

This study's central focus is on Ontario's remediation sector and the domestic market that it serves. The report, however, does make several references to the U.S. remediation industry and its market. In this regard, the following points should be noted: there is comparatively more information available on the U.S. industry, relative to the domestic industry; the U.S. has a longer history in the remediation market; and the size of, and access to, the U.S. market present significant export opportunities for Ontario firms. These factors provide a rationale for making comparisons with and extrapolating from the U.S. experience.

Approach

This study embodies results of the following activities:

Literature Review - Literature, pertaining to the commercial aspects of the industry, was acquired through on-line searches of the Lexis Nexis database[1] - a list of key words used in the search is provided in Appendix I. In addition, supplementary information was gathered from the following organizations: Environment Canada, MOEE, Canadian Environmental Industry Association (CEIA, Ontario Chapter) and Arthur D. Little, Inc. (management consultants).

Survey of Firms - There is a paucity of statistical information pertaining to the domestic remediation industry's size and economic activity. In fact, Statistics Canada, which is the predominant source of quantitative information on a myriad of domestic sectors, does not provide specific coverage of this sector. As a result, it was necessary to gather information via an industry survey. The survey's methodology and results are presented in Appendix II.

Interviews (Remediation Firms) - The primary objective of interviewing a sample of remediation firms was to determine industry-specific competitiveness issues and the outlook for the sector. This information was used to supplement and qualify statistical information generated through the industry survey.

Interviews (Firms Linked to Remediation): As one aspect of assessing the industry's growth potential, discussions were held with organizations that directly or indirectly drive demand for remediation services. These types of organizations include banks, insurance companies, and corporations that require remediation services, such as oil and chemical companies.

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[1] Lexis Nexis is an on-line information service provider that covers over 4,000 sources of information, including business magazines, journals and newspapers.

CHAPTER 1

INDUSTRY DESCRIPTION

1.0 Background

There are soils that are contaminated with a wide range of industrial chemicals including pesticides, industrial solvents, inorganic acids and bases and liquid wastes containing heavy metals. In addition, there are large numbers of contaminated sites as a result of accidental spills from petroleum hydrocarbon products ranging from light refined products to heavy crude, tank bottoms and used oil. Many of the problems related to contaminated sites have been caused by leakages from underground and above-ground storage tanks as well as other facilities for storing and transferring petroleum fuel products and service stations and power generating plants (Electric Power Research Institute, 1990).

The problem of site contamination has spawned the development of remediation services and technologies, described below.

1.1 Industry Definition

Environmental remediation includes the clean-up of contaminated soil, water, sediments and groundwater. These services are reactive rather than proactive. That is, they are provided in response to contamination and not as a means of pollution prevention. As such, remediation services do not include the provision of waste management services or pollution control equipment.

This study focuses on the soil and groundwater components of the remediation market in Ontario. These components, relative to sediment and water remediation, are predominantly driven by economic factors - primarily real estate transfer.

Site Remediation Services

The typical site remediation project involves the following range of activities:

> Environmental consultants first conduct a field investigation of the wastes and site, focusing on characteristics that help determine possible remediation technologies. Investigations usually focus on identifying and quantifying contaminants and wastes such as metals, volatiles, semivolatiles and petroleum hydrocarbons through sampling, chemical analyses and other activities. These studies also seek to characterize the site and determine

distribution of contaminated media, transport routes, environmental chemistry and other factors. During or after a site investigation, the consultants might conduct a risk assessment, providing a clearer picture of the potential risks that the site may pose to human health and the environment.

Once consultants have characterized the contaminated site, they evaluate different remediation technologies. Laboratory and benchscale feasibility studies assess whether a technology will perform well at a specific site. The results enable consultants to evaluate and select a remediation technology or prepare preliminary process designs and determine equipment needs.

Additionally, the consultants might conduct pilot studies or field demonstrations to develop design criteria or to demonstrate a technology's applicability in the field. The need for pilot studies is determined by the complexity of the site and whether or not contaminants are common. (Bowen, 1995)

As the following table indicates, the range of services described above can be divided into three main categories of environmental remediation activities: 1) consulting engineering, 2) analytical, and 3) remediation construction.

SERVICES IN SITE REMEDIATION

Services	Description
ANALYTICAL	
Site characterization studies	sampling, analysis, review of historical data and regulations and report with recommendations
Hydrogeological services	investigation of subsurface conditions including drilling, sampling, pumping tests, analysis
Testing	testing of soil and water samples
CONSULTING/ENGINEERING	
Assessment	evaluation of need for and alternatives for remedial action plans; may include process testing and evaluation
Feasibility studies	laboratory and/or pilot plant operation of selected remedial process
Process design	development of tasks and work plan with schedule and cost budget
Approval process	submission of remedial action plan to regulatory authorities for approval
Project management	multiple tasks associated with execution of project on time, on budget and in compliance with MOEE approvals
Contracting	hydrogeological, civil, technical process (e.g., biological, thermal, encapsulation)
REMEDIATION CONSTRUCTION	
Shipping/Disposal	movement of contaminated materials to designated areas
Processing	receiving and remediating/recycling contaminated soils

The remediation industry's activities are characterized as "intellectual services," due to the fact that, as the preceding table indicates, site clean-up involves an interdependent set of analytical, consulting and clean-up activities.

Remediation firms either:

1. specialize in one or more of the services listed above;

2. undertake all of these services; or

3. act as project managers, coordinating interdisciplinary activity - i.e., contracting firms with subspecializations to participate in projects.

Moreover, the level of service provided by remediation firms depends upon two factors:

1. the complexity of site contamination - i.e., the number and type of contaminants ; and

2. the level of cleanup required by clients.

It should be noted that most firms providing remediation services are diversified in other industries, mainly environmental services, engineering consulting and construction. There are, however, a few small companies that derive all or most of their revenue from the provision of remediation services. In comparison, larger firms tend to undertake remediation services as a sideline activity.

Site Remediation Technologies

Remediation technologies use physical, chemical or biological processes to destroy or reduce the volume, toxicity and mobility of contaminants in soil and groundwater. These technologies are classified as follows:

1) In-situ technologies which remediate soil in its original location; and

2) Ex-situ technologies which allow for treatment after the soil is excavated and moved to an on or off-site treatment facility.

SITE REMEDIATION TECHNOLOGIES[2]	
In-situ	**Ex-situ**
volatilization	surface bioremediation
steam/heat stripping	enhanced bioremediation
bioremediation	soil slurry bioreactor
soil leaching	low temperature thermal desorption
isolation/containment	high temperature thermal destruction
vitrification	beneficial reuse
	chemical extraction (soil washing)
	solidification/stabilization

The marketplace for remediation services is dominated by four cleanup options:

1. Low temperature thermal desorption (lttd)

2. Bioremediation/composting

3. Soil vapour extraction (volatilization)

4. Landfill disposal.

In addition to these options, a niche market exists for specialized cleanup technologies that address the cleanup of specialized chemicals, such as PCBs, which cannot be treated by other remediation technologies.

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[2] For a description of individual technologies, refer to "Site Remediation Technologies Used in Ontario," MOEE, 1996. Also, for a comparison of costs of various remediation technologies, refer to "Bioremediation of Petroleum Contaminated Soils - An Innovative, Environmentally Friendly Technology," Environment Canada, 1994, pg. 10

1.2 Industry in Perspective

Comparisons, in terms of size and activities, between the Ontario remediation industry and selected other provincial industries are provided in the following table.[3]

INDUSTRY	Revenues	Employment	R&D (% of sales)
Remediation	375 $M	1,500	6.00
Environmental Sector	2,500 $M	30,000	n/a
Industrial Chemicals	4,826 $M	9,188	0.8
Plastic Products	4,516 $M	29,124	0.3
Computer Hardware	5,156 $M	8,917	11.2

As the above comparisons based on revenues and employment indicate, the direct impact of this industry on the provincial economy is quite small relative to other industries. The industry's indirect impact, however, could be substantial as a result of its R&D undertakings, which are comparatively large: apart from potential spinoffs to other industries, R&D leads to the clean-up of contaminated sites and, hence, increases the value of properties. Moreover, the clean-up of contaminants provides an intangible benefit: namely, the protection of human health.

It is beyond the scope of this paper to measure the industry's indirect impact on the provincial economy. The point, however, is that the industry should not be dismissed on the basis of its relatively diminutive size. Moreover, it should be noted that the remediation industry is a sub-sector of the environmental industry, which makes a significant contribution to the provincial economy (refer to table above).

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[3] Data for the remediation industry are for 1995.. Data for the environmental industry are for 1990 (latest figures available). Data for the other industries are for 1994. All dollars are nominal.

KEY POINTS

- Remediation is an "intellectual discipline" - i.e., it involves an interdisciplinary approach to solving site contamination problems.
- Large firms, operating in the remediation market, are diversified and tend to undertake remediation only as a sideline activity. Small firms, on the other hand, tend to focus on specific technologies or niche services.
- Remediation is a vital service, restoring economic value to land and protecting human health. Moreover, these benefits foster the intensification of cities.

CHAPTER 2

INDUSTRY STRUCTURE

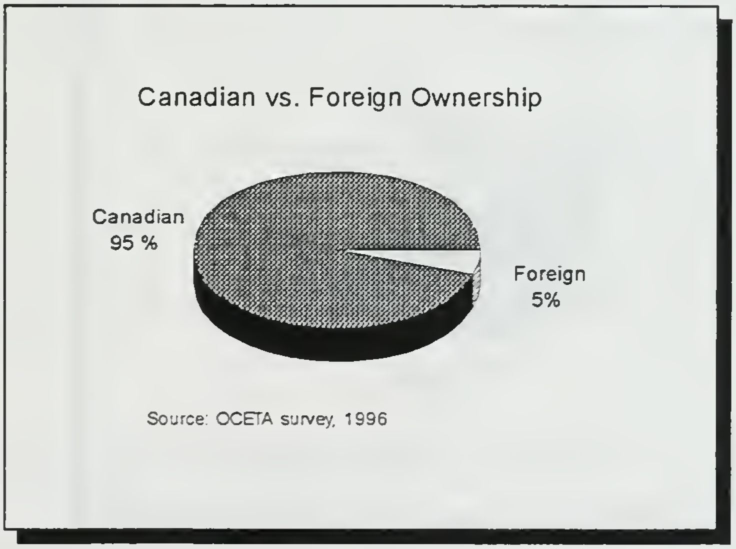
The term "industry structure" refers to the underlying characteristics of an industry that determine: 1) the means by which a sector organizes its activities - e.g., provision of services and administrative activities; and 2) the nature of competition between firms in the domestic and international sector. These characteristics, described in the subsections below, determine a sector's competitiveness.

This section is intended to be descriptive, as opposed to analytical. An analysis of the relative strengths and weaknesses of the sector's structure is presented in the "Industry Issues" and "Outlook" sections of this report.

2.1 Ownership and Concentration

Ownership

Survey results (OCETA, 1996) indicate that the majority (95%) of firms in the Ontario remediation industry are Canadian-owned, private companies (88%).



Source: OCETA survey, 1996

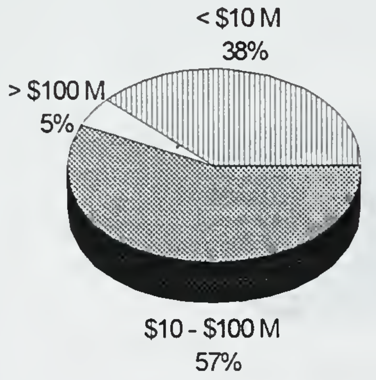
These results indicate that the domestic industry has a high degree of autonomy in determining corporate mandates and market strategies. That is, unlike industries characterized by a high degree of foreign-ownership, this industry's strategic directions are not tied to decisions made in corporate headquarters located in other jurisdictions.

Concentration

The term "industry concentration" refers to the proportion of an industry's revenues that are attributed to a specific number of its largest firms - usually the four to eight largest firms in terms of sales. This measure reflects the degree of competition within the domestic industry and, hence, profit potential and corresponding attractiveness of the industry to investors. For example, a highly concentrated industry is indicative of a monopoly or oligopoly: in this circumstance, profitability tends to be high vis-a-vis industries with a lower degree of concentration (i.e., highly competitive industry). Hence, investors will be attracted to highly concentrated industries, which tend to have higher profit potential.

Extrapolating from survey results (OCETA, 1996), it appears that the provincial remediation industry does not have a high degree of concentration (see chart below), which accounts for the fact that profit margins are low. In comparison, the domestic auto industry is highly concentrated: the big three (General Motors, Ford and Chrysler) controlled 73% of domestic sales in 1993 (Ontario Sector Profiles: Light Vehicle Manufacturers).

Revenues by Size of Firm



Source: OCETA survey, 1996

The following observations regarding competition within the domestic industry were drawn from the survey:

- there is little competition from outside Ontario in this market;
- consulting firms tend to view other consulting firms as their main competitors;
- technology firms view other technology firms as well as dig & dump haulers as their main competitors; and
- consulting firms and technology firms generally see each other as potential partners rather than pure competitors, although there are some exceptions to this rule.

2.2 Human Resources

Based on interviews with companies (OCETA, 1996), it appears that this sector has a diverse, highly-skilled workforce. A science-based education is most prevalent among the industry's employees (estimated 70% of workforce): specifically, engineering, hydrogeology, and pure sciences. In addition, firms indicated that they required the skilled services of well drillers, diggers and equipment operators.

In addition to the skills that employees bring to this industry, company-specific training is generally required in order to operate a firm's proprietary technology and/or apply its remediation methodologies.

As indicated in the previous chapter, site remediation projects involve a diverse range of activities that must be coordinated. Hence, it is not surprising that firms interviewed indicated that project management skills also are very important.

It should be noted that only one firm interviewed mentioned a problem finding skilled employees.

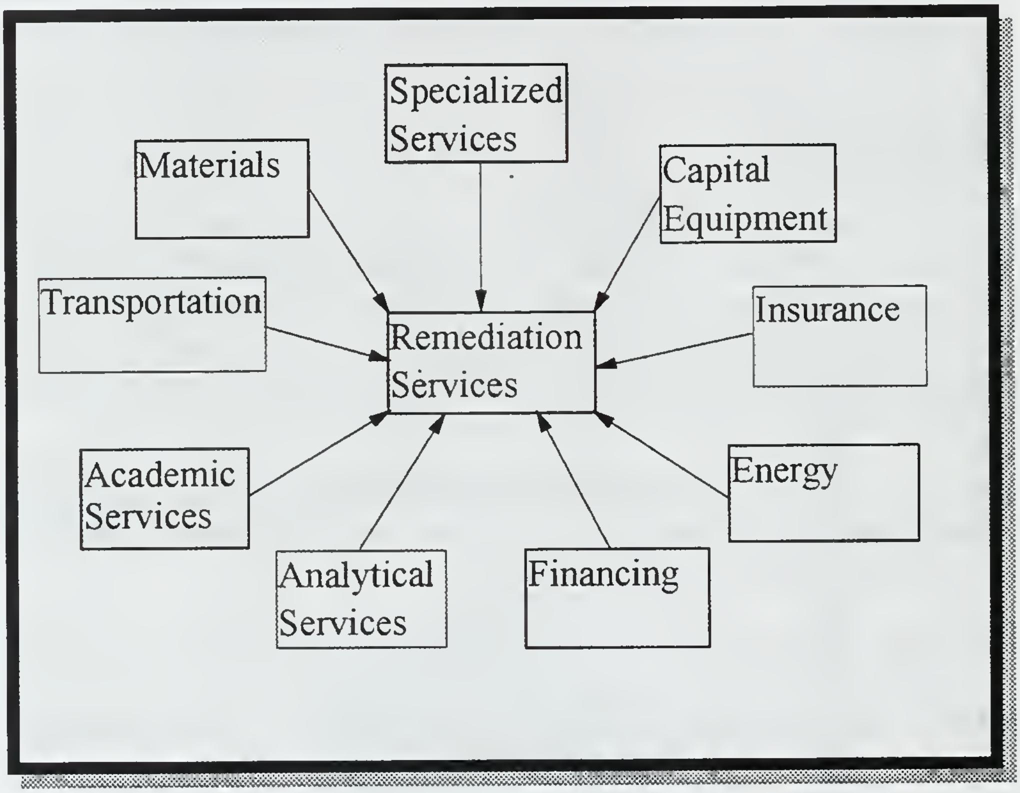
2.3 Linkages & Clusters of Activity

Inputs To Remediation Services

The term "linkages" refers to interdependent relationships between firms, both within and across sectors. Forward linkages are formed between a firm and purchasers of its services. Backward linkages are formed between a firm and its suppliers of inputs; these linkages are sometimes referred to as "enabling" services due to the fact that they enable the purchaser to perform a specific task.

In general, the economic significance of an industry's linkages is determined by the origin of goods and services provided to the sector, the amount of value-added embodied in these inputs and the transfer of technology within the sector and between the sector and its suppliers. This is the basis on which the economic significance of the remediation cluster is assessed. Conversely, this is the basis for determining structural weaknesses that need to be addressed.

As the following chart and table indicate, the remediation sector depends on inputs from a variety of manufacturers and service providers.



The above chart represents the remediation sector's backward linkages with its suppliers. The remediation sector, which forms the nucleus of the cluster depicted in the chart, was described in the previous chapter of this report. Each of the sector's main suppliers, identified here, are described in the following table.

EXAMPLES OF INPUTS TO REMEDIATION SERVICES

Category	Product/Service
Capital Equipment	▸ Manufacturers of screens, pumps, filters, and dredging equipment required for water cleanup ▸ Analytical and monitoring equipment required for the detection of trace chemicals in samples. ▸ Thermal desorption units
Materials	▸ Chemicals (e.g., biological inoculants and nutrients), plastics (e.g., plastic membrane)
Transportation	▸ Hauling contaminated materials to landfill or ex-situ treatment facilities
Energy	▸ Electricity to operate equipment (e.g., kilns)
Financing/Insurance	▸ Liability insurance
Academic Services	▸ Several community colleges have established technical training programs for soil and water sampling and laboratory analysis and reporting.
Specialized Services	▸ Environmental laboratories ▸ Demolition and haulage companies ▸ Well diggers ▸ Suppliers of containment systems and maintenance services for such systems ▸ Repair and maintenance technicians to service the complex electronic and mechanical equipment used throughout the sector ▸ Tool and die makers
Labour (external to sector)	▸ Heavy equipment operators ▸ Drill operators for soil sampling ▸ Construction labour (e.g., construction of concrete barriers for the containment of toxins)

2.4 Marketing

The industry markets its services in the following ways:

- Trade shows
- Trade missions
- Visiting delegations for site tours

The sector's secondary form of marketing includes the use of:

- Listings and trade directories
- Corporate promotional materials
- Media
- Internet
- Technical papers - delivered at conferences

Most companies interviewed use a variety of channels to market their products and services. For example: it is common for small technology companies to market their technologies and services through large engineering firms, especially where they can link with the project management services of a larger company; in export markets, many companies market their technology or services through a local partner or distributor.

2.5 Patterns of Trade

Based on extrapolations from survey results it appears that the industry is not highly export-oriented relative to other industries (refer to table of comparisons below).

INDUSTRY	Exports[4] (% of sales)
Remediation	33
Automotive Vehicles	90
Computer Hardware	74

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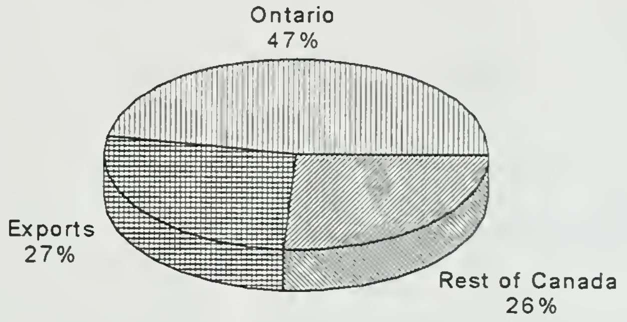
[4] Source: OCETA survey, 1996; and Ontario Industry Profiles, MEDTT, 1996. Figures represent industry averages.

This observation must be qualified however: large firms tend to be highly export-oriented (53%) vis-a-vis small firms (10%) (refer to following charts).

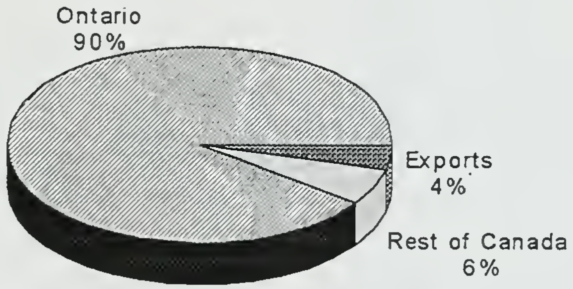
Revenue by Region: Large Firms



Note: Large firms are those with revenues greater than $10 M.

Source: OCETA survey, 1996

Revenue by Region: Small Firms



Note: Small firms are those with revenues under $10 M.

Source: OCETA survey, 1996

The export of services is primarily to the U.S. and, to a minor extent, Europe. Most of these exports are in the form of consulting engineering and project management or turnkey services. Firms exporting these services do not tend to use remediation methods developed by Ontario technology firms.

2.6 Industry Infrastructure

The main components of the industry's infrastructure include:

- The Ontario Centre for Environmental Technology Advancement;
- The Canadian Environmental Industry Association (Ontario Chapter);
- Ontario Centres of Excellence (Waterloo Centre for Groundwater Research);
- MOEE - Green Industry Office; and
- Consulting Engineers of Ontario.

These organizations provide a range of services including regulatory assistance, general business counselling and testing of new technologies. For more information on these organizations refer to Appendix III.

It is noteworthy that firms, interviewed in the course of this study, identified links with universities and Centres of Excellence, notably the Waterloo Centre for Groundwater Research, as important to their competitiveness.

KEY POINTS

- Domestic remediation firms face **little import competition**. The domestic market, however, is highly competitive and, consequently, profit margins are low.

- **Most firms are domestically-owned and operated**; hence, there are no corporate barriers to exploiting export opportunities or to developing proprietary technology.

- **Highly skilled workforce** with no shortage of skilled labour.

- **Strong industry linkages** - i.e., firms have access to a full range of suppliers and have strong strategic relationships with foreign partners.

- **Export-orientation** is high among large firms but low among small companies, which tend to lack the economies of scale to exploit export opportunities.

- **Solid industry infrastructure** - Firms have access to industry associations and universities/research organizations (e.g., firms identified links with universities and Centres of Excellence, notably the Waterloo Centre for Groundwater Research, as important to their competitiveness).

CHAPTER 3

BUSINESS CLIMATE

The following discussion focuses on those factors, external to the sector, that have an impact on the demand for the industry's services. This section covers: (1) general conditions pertaining to the environmental industry that have an impact on the remediation industry, and (2) conditions specifically pertaining to the remediation subsector. This coverage is provided for the U.S., Canadian and Ontario business environments.

3.1 United States

The development of the U.S. environmental industry is portrayed as having two distinct but overlapping phases: the first based on government regulation and the second based on the integration of the environment into the economy - i.e., the cost/benefit of "going green" (Environmental Business Journal (EBJ), April/May 1995).

Regulatory Drivers of Demand

The first phase of development was fostered by punitive measures to make those directly responsible for pollution pay for years of abuse and inaction.

> "While a well-developed policy on environmental protection is an essential first step in creating a viable marketplace, legislation is the sustenance on which the "green" business community in the West has always thrived. When governments pass laws that require industry to cut back on emissions, remediate sites, or conduct environmental audits and impact assessments, markets are created for environmental professionals offering consulting services and clean technologies" (Market Europe, November 1995).

In the case of the U.S. remediation industry, federal, state and local regulations designed to protect human health and the environment have been the driving force behind most site cleanups and, hence, the industry's development. In fact, these regulations provided U.S. environmental firms with a competitive advantage over firms in other nations that did not enact comparatively stringent environmental laws.

The most significant set of U.S. regulations is based on the Comprehensive Environmental Response, Compensation and Liability Act (Superfund) and the Resource Conservation and Recovery Act (RCRA). These laws specify state-cleanup levels and sites that need to be investigated and cleaned-up. In addition, they outline the rules and procedures for investigating sites, setting goals, choosing remedial actions and implementing them (Bowen, 1994).

Despite their initial role in industry development, there are three main reasons why environmental regulations will not continue to foster the growth of environmental industries.

1. **Diminishing Returns:** Environmental regulations have reached a point of diminishing returns. That is, growth in the environment industry, accruing from regulations, has declined and is unlikely to resume its historical path unless regulations are tightened, which seems highly unlikely. The Environmental Business Journal cites evidence of this stating: "An industry billed as recession-proof by some analysts turned out to be recession-prone, highlighting the importance of the general health of the economy to the environmental industry and the dangers of dependence on regulations." This is borne out by the industry's declining rate of growth (refer to industry growth rates in Chapter 5, "Industry Performance").

2. **Economic Inefficiency:** Site clean-up criteria, as specified by law in the U.S., tend to be generic - i.e., the same level of clean-up is required for all sites, regardless of the proposed use of the land (e.g., residence vs. industrial site). This creates economic inefficiency to the extent that resources are devoted to cleaning-up sites beyond necessary levels of cleanliness, given the proposed use of the land.

   As a result, the U.S. Superfund program, which was established to restore the environmental health of lands contaminated by hazardous waste, is on the chopping block. This program has been a significant driver of demand for remediation services. With the program's uncertain future, however, many remediation firms have languished in recent years.

3. **Government Budget Constraints:** Declining federal budgets will have a negative impact on Superfund, Department of Environment (DOE) and Department of Defence (DOD) markets, as well as general federal enforcement activities. This constraint, in conjunction with the contention that generic regulations are creating economic inefficiencies, makes it highly unlikely that Capitol Hill will pass more stringent environmental laws.

While environmental services driven by regulation still represents the majority of revenues in the environmental industry, customer demand is replacing these services with pollution prevention and resource recovery investments not wholly dependent on regulations (EBJ, April 1995). This marks the move to the second phase of the industry's evolution.

Economic Drivers of Demand

It is purported that the second phase of the overall U.S. environmental industry's development will be powered by the demand for economic sustainability - i.e., strategic environmental management and pollution prevention - as the traditional compliance-oriented consulting business dries up.

> "Environmental companies must no longer subsist predominantly on short-term pollution control or waste management "fixits" in response to regulatory drivers. They must provide enduring value through long-term, resource-orientated solutions to environmental unsustainability in anticipation of return on investment and long-term competitive advantage" (EBJ, April/May 1995).

A new mentality prevails: pollution prevention pays. That is, there is a growing recognition that the efficient use of raw materials, concomitant with energy and waste reduction, serves the dual purpose of increasing profitability while reducing or eliminating pollution.

According to the EBJ, the emergence of economic rather than regulatory drivers will play a significant role in site remediation. The journal states that the remediation market is in the process of setting itself apart from its formative regulatory base (i.e., Superfund). Traditionally, demand for the industry's services was based on the cleanup of federal facilities which, in turn, were driven by law. Now, however, similar to the pattern of evolution in the overall environmental industry, remediation firms are experiencing emerging demand from privately-instigated sources that are motivated by the potential economic value of the property rather than compliance with regulations.

> "The future of site remediation will not be driven by parts per million readings but by real estate transactions" (EBJ, April 1995).

The primary impetus for this emerging source of business will come from mergers and acquisitions and discontinued operations of industrial companies: those inheriting historical problems and those who must clean in order to sell.

Other Drivers of Demand

The U.S. industry's drivers of demand are categorized and quantified in chapter 5, Industry Performance.

3.2 Canada/Ontario

Prelude to National and Provincial Clean-up Guidelines

As discussed above, the U.S. is moving from a regulatory-driven market to one that is based on economic drivers. The Canadian market, in contrast, has always been based on economic drivers.

In contrast to the regulatory-driven U.S. market, the domestic market, from its inception, has been driven by real estate transfers and, as part of this process, the desire of stakeholders (i.e., buyers, sellers and lenders) to minimize liability for potentially contaminated sites.

Ontario Guidelines and Standard Agreement

(a) Guidelines

Ontario first released clean-up guidelines in 1989, "Guidelines For The Decommissioning and Cleanup of Sites In Ontario." The MOEE has recently prepared a revised guideline, "The Guidelines for Use at Contaminated Sites," which replaces 1989 and 1993 guidelines.

The revised guideline, released in June 1996, provides clearer, more workable directions on managing and reusing contaminated sites and does not change the legislative powers or the regulatory mandate of the MOEE. The guideline provides advice and information to property owners and consultants to use when assessing the environmental condition of a property, when determining whether or not restoration is required and in determining the kind of restoration needed to allow continued use or reuse of the site. The ministry has provided the guidelines, along with supporting documentation, to assist landowners in making decisions on soil and/or groundwater quality for proposed or existing property uses. The guidelines serve as common benchmark criteria against which interested parties (land owners, lenders, prospective investors, etc.) can evaluate the condition of sites.

Under the new guideline, the level of soil cleanup is dependant on the intended use of the land. For example, property to be used for housing, schools, parks and recreation will need a higher degree of cleanup to ensure human health is protected.

Public communication is often an element in the site restoration process, particularly when a change in land use is involved. The method of public communication will depend on the complexity of the situation and the range of issues involved. The guideline suggests different levels of communication for the range of site restoration approaches.

It should be noted that a change in land use cannot be completed without municipal approval.

(b) Standard Agreement

Issues of environmental liability, and in particular, liability for contaminated sites, have resulted in a lack of certainty for the business community. MOEE recognizes that current environmental legislation does not provide absolute clarity on the issue of environmental liability. For example, anyone assuming care or control of a property runs the risk of accepting the full responsibility of any past environmental damage at that site. In the past, banks, other lending institutions and municipalities have incurred such responsibilities with a site when foreclosing on a mortgage or tax sale.

To address this situation, MOEE has introduced several initiatives to clarify and provide more certainty in this area. In December 1995, MOEE developed a standard agreement for lenders that limits their liability when simply investigating a site's condition, provided that no additional damage is done to the site. In August 1996, MOEE released a Liability Policy Framework for public discussion and comment. This Framework builds upon the work accomplished to date and attempts to establish a foundation for future cooperative work with affected stakeholders in these areas. The work undertaken through this initiative will form the foundation for future legislative reform.

Canadian Council of Ministers on the Environment (CCME)

The CCME, established in 1989, was given a mandate to deal with environmental issues on a national basis, including the above situation. Accordingly, the council worked with the provinces to develop a national framework for site assessment and remediation in 1990. The framework, designed to provide a simple classification system, employs two criteria: 1) the establishment of generic standards for the cleanup of all sites, and 2) the setting of standards on a case-by-case basis, with cleanup criteria tailored to the specific conditions of each site and its proposed future uses (e.g., residential vs. continued industrial use) - commonly referred to as the "risk-based" or "risk assessment" model.

Government Programs/Projects

In 1989, the CCME acknowledged the need for a consistent national approach for the prioritization and remediation of high-risk[5] contaminated sites in Canada. In response to this need, CCME established the National Contaminated Sites Remediation Program (NCSRP), supported and administered through federal-territorial bilateral agreements. The program was established to:

- ensure that high-risk orphan[6] sites would be cleaned up; and
- stimulate the development and demonstration of new and innovative clean-up technologies that would bring international recognition for Canada's leadership in this field.

The DESRT (Development and Demonstration of Site Remediation Technology) program was established as a component of the NCSRP. Its intended function was to address the NCSRP objective of working with industry to stimulate the development and demonstration of new and innovative technologies with the potential to resolve problems that are critical to the environmental remediation of contaminated sites.

The NCSRP and DSERT were fixed-term programs which ended in 1995. The sunset of these programs, which in part provided a function similar to the U.S. Superfund, has eliminated one source of demand for domestic remediation services and, at the same time, limited the industry's ability to test new technologies. This issue is discussed in more detail in the next chapter, Industry Issues.

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[5] High-risk contaminated sites are areas containing toxic and hazardous substances at levels that pose immediate or imminent threats to human health or the environment.

[6] A site is considered an orphan site if the parties responsible for the contamination cannot be identified or are unable to pay for the clean-up, and where governments consequently must undertake the task.

Despite the loss of the NCSRP and DSERT, there are two other federal programs that can be accessed by companies who are interested in developing and commercializing new technologies:

1. The **Great Lakes 2000 Cleanup Fund**, introduced as part of the federal Great Lakes Action Plan in 1990, is focused on rehabilitating fish and wildlife habitat, remediating contaminated sediment, controlling combined sewer overflows, stormwater and rural runoff and optimizing municipal wastewater treatment plants. In addition to its central focus, the program has also funded site remediation demonstration projects.

2. The **Technology Partnerships Canada** (TPC) program was established to assist small and medium-sized technology firms that require additional financial resources to undertake the development and commercialization of environmental technologies. The program is based on an "investment approach" to technology, with real risk and reward shared between the government and the private sector. TPC funding comes from both federal government contributions and repayments from companies with successful TPC projects. A key element of the program's approach is that these funds will be used as investments, where successful projects will fund future TPC investments. Government will share in the upside returns on successes through royalty repayments on successful projects. TPC will recycle all repayments back into the fund for future investments.

KEY POINTS

- Remediation firms operate in a market that is predominantly **driven by real estate transfer** and, as part of this process, by customers' desire to reduce exposure to liability for the potentially hazardous effects of site contamination.

- There is a **shifting emphasis in the U.S.** market from regulatory to economic drivers of demand. As the U.S. economy grows, this presents an opportunity for Ontario firms to export services.

- The **merging of environmental and economic objectives** are leading to pollution prevention and resource recovery initiatives which, in the long-run, are likely to reduce demand for remediation services.

- It should be noted that a change in land-use cannot be completed without municipal approval.

CHAPTER 4

INDUSTRY ISSUES

This section provides an examination of the industry's competitiveness challenges and barriers to exploiting business opportunities. Generic issues affecting the competitiveness of the overall Ontario environmental industry are presented first, followed by a discussion of industry-specific issues, identified through a literature review and company interviews.

4.1 General Issues: Broader Ontario Environmental Industry

In August of 1995 The Impact Group undertook a survey of Ontario environmental companies to determine, in part:

1. what environmental companies in Ontario believe to be the most significant business barriers to their growth, past and present; and
2. the most important environmental issues affecting these companies as they relate to potential obstacles and opportunities over the coming years.

Participants were asked to indicate the degree of importance (past and future expectations) of generic business barriers on the basis of the following choices: not applicable, not important, somewhat important, important or very important. The degree of importance was calculated by combining "somewhat important," "important" and "very important" responses.

A summary ranking of participants' responses, which are deemed to relate to the remediation subsector, is displayed in the following table.

OVERALL ONTARIO ENVIRONMENTAL INDUSTRY ISSUES

SUMMARY OF PAST AND FUTURE BARRIERS BY IMPORTANCE		
CATEGORY	**PAST %**	**FUTURE %**
1. ACCESS TO INTERNATIONAL MARKETS	78	86
2. ACCESS TO DOMESTIC MARKETS	72	86
3. LOW DOMESTIC REGULATORY STANDARDS	69	70
4. AVAILABILITY OF NEW TECHNOLOGY	58	81
5. ACCESS TO INVESTMENT CAPITAL	56	75
6. ACCESS TO DEBT CAPITAL	51	64
7. GOVERNMENT FINANCIAL ASSISTANCE	47	63
8. GOVERNMENT MARKETING ASSISTANCE	37	43

The table clearly indicates that all company barriers listed are expected to increase in importance over time. Unfortunately, The Impact Group survey does not provide an analysis of these barriers or an explanation of why they are expected to increase in importance. Some of these generic issues, however, are addressed in the next section, "Remediation Specific Issues," which is based on interviews with firms that provide remediation services. In addition, research undertaken by the U.S. National Environmental Technology Applications Centre (NETAC) indirectly addresses some of these issues, through the examination of environmental technology firm's key barriers to accessing venture capital.[7] These barriers include:

1. **Unpredictable commercialization pathways** - Rules for environmental compliance may change during the technology development phase. Consequently, by the time a technology to address a specific problem is ready for market, the conditions which define compliance may have changed, making the technology irrelevant.

2. **Lack of management experience** - Investors reject deals when technologists with no prior business experience head start-up companies. Strong technical expertise does not necessarily translate into marketing skills. Firms which include partners who have good business skills, in addition to technical expertise, are more likely to attract investors.

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[7] Although this research is based on a U.S. survey, the issues identified are generic in nature and can reasonably be expected to apply to a range of industries across many industrialized nations.

3. **Potential liability** - Some venture capital firms prefer to invest solely in proprietary products which are then sold to environmental services companies. This strategy is adopted in order to avoid any involvement with specific compliance issues or site cleanup liability issues. Similarly, large companies with successful environmental technologies developed for internal use hesitate to market them, as they fear being sued in the event that their technology does not work under a specific set of regulatory criteria.

4. **Lack of adequate data on performance** - Companies with new, untried environmental technologies are often at a disadvantage in terms of developing performance data for their products. Few firms are willing to risk being put out of compliance by using an untried technology. Developers get caught in a classic "Catch 22" in that they do not have performance data and no one is willing to take the risk of using a technology without supporting data.

4.2 Industry-specific Issues: Ontario Environmental Remediation Companies

Economic Climate

As indicated in the previous chapter, the primary driver of demand for remediation services is real estate transfer, which corresponds to the overall growth of the economy. The rate of domestic growth and movement in the real estate market affects the rate of growth in remediation services. Economic forecasts suggesting renewal would imply growth opportunities for this sector.

Technology Development

Newer approaches have not been used in the field as often as established technologies (e.g., thermal desorption) and, therefore, extensive data about past performance and cost are not always readily available for analysis (Bowen, 1994). Consequently, firms require access to contaminated sites in order to test new technologies. Often, testing has taken place on government sites (e.g., military sites), as private property owners are generally only willing to establish contracts with companies using "proven" technologies. In this regard, a further complicating factor is that Canadian firms have to test their technologies in the U.S., regardless of whether they have been tested and approved in Canada, in order to get EPA approval for Superfund-site work.

A more pressing problem is that large firms, which have the export capability and capital, tend not to support technology development. Consequently, the Ontario industry has few leading edge technologies. This points to a need for more linkages between large firms and small technology companies to both develop and commercialize new technologies. Large companies will need these technologies to remain competitive in international markets.

The issue of technology development may be further exacerbated by issues surrounding the application of existing technologies which, themselves, draw on limited resources and generate pollution (Bowen, 1994). For example, incinerating excavated soil in kilns is very expensive and results in the emission of noxious gases. This is a case in which the cure may pose some highly undesirable side-effects. Accordingly, environmental interest groups are likely to place pressure on governments to ensure that this situation is rectified. This, In turn, would place pressure on remediation firms to adopt or develop more "environmentally friendly" solutions.

Despite the various impediments to undertaking R&D, firms indicated that R&D tax credits have facilitated the development of new remediation technologies. In fact, several Ontario firms are working on new technologies and perceive that these will be important to their future growth.

Increased Range of Services

Given the broad range of complex services that are required to undertake a site remediation project, an increasing proportion of customers are demanding a project management and/or turnkey approach to site clean-ups. This does not pose a problem for large firms that provide a range of services and have the critical mass to manage large undertakings. Smaller firms, however, generally lack these capabilities and, as such, must develop strong strategic relationships with other firms (SMEs or large firms) or face consolidation and mergers.

Declining landfill costs

During the early 1990s, landfill disposal costs for non-hazardous waste decreased from over $100 to approximately $30 per tonne in Ontario. This, contend remediation technology firms, reduces demand for their services. Consequently, unit costs for remediation technologies (LTTD and bioremediation) have been forced down (Benazon, 1995).

The following table provides a comparison between the cost (per tonne) for landfill disposal vs. those of three prevalent site remediation technologies (Benazon, 1995).

Remediation Option	**Cost/tonne**
Landfill Disposal	$30
Thermal Desorption	$30 - 60
Bioremediation	$20 - 80
Soil Vapour Extraction	$15 - 30

Although the bottom of the cost ranges for two of the technologies, listed above, are lower than the per unit cost for landfill disposal, it should be noted that remediation technologies require more time to achieve site clean-up vis-a-vis the landfill option. This represents costs, over and above landfill disposal costs, for site owners and developers; these costs are not reflected in the table.

Typically, hazardous waste management costs exceed $30 per tonne and consequently, an opportunity exists for firms to develop and/or apply niche remediation technologies.

Estimating The Cost of Clean-ups

In the U.S., project managers are often unable to estimate what is the most a cleanup project could cost, the least or even the average (Engineering News-Record, November 1995). According to Stephen W. Meador (manager of the U.S. DOE's Germantown, Md.-based environmental restoration program), external risks such as regulatory change, public involvement and possible litigation are commonly incorporated as contingencies of as much as 35 - 40%. Nevertheless, he claims that overruns are still rampant. According to another source quoted the Engineering News-Record (November 1995), remediation projects still run 30 to 50% in the red.

"There are still no clear recipes for remediation, because these are not cookbook problems," says Meador. Nevertheless, there will be increasing pressure placed on remediation consultants to provide more precise estimates as insurance companies become more active in the market for environmental insurance. Accordingly, remediation firms are being challenged to develop a cost framework for proposed remediation projects and to provide documentation of the total costs at comparable sites. In many cases, however, there may be no comparable sites. As such, consultants can only provide an overall cost framework.

CHAPTER 5

INDUSTRY PERFORMANCE

Given the short history of the Ontario remediation industry and its small size relative to other industries, Statistics Canada and environmental industry associations have compiled little or no statistical information pertaining to site remediation activities. Consequently, data pertaining to Ontario industry trends are virtually nonexistent. In the absence of such information, a review of trends and forecasts for the U.S. remediation market and industry are provided, although such figures, too, are limited.[8] Despite quantitative limitations, it should be noted that this review is considered to be instructive for the following reasons:

- the U.S. market is more mature and, hence, is likely to provide some lessons from its experience;
- as indicated above, there are commonalities between U.S. and Ontario business environments; and
- proximity of the U.S. market to Ontario and its size relative to the Ontario/Canadian market provides a source of revenue for many Ontario firms and is likely to provide future export opportunities for the domestic industry.

5.1 U.S. Industry and Market Trends

The following trends and market analysis are drawn from the Environmental Business Journal, October 1995:

- **Shrinking Revenues** - Industry revenues shrank from $7 billion in 1993 to $6.5 billion in 1994 (refer to tables below).
- **Shifting Patterns of Demand** - The following table provides trends in demand for the major components of the U.S. site remediation market.

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[8] It is beyond the scope of this paper to cover remediation market trends and industry performance for a range of international markets. Moreover, very little data pertaining to such markets are available. Nevertheless, it is interesting to note that Eastern and Western European remediation markets are expected to expand significantly (Market Europe, November 1, 1995; and Chemistry and Industry, June 6, 1994).

PATTERNS OF DEMAND FOR REMEDIATION SERVICES[9]

Source of Demand	1992 $M	% of Mkt.	1993 $M	% of Mkt.	1994 $M	% of Mkt.
DOE[10]	880	14%	958	14%	1208	19%
DOD[11]	810	12%	1049	15%	1140	18%
Superfund	1350	21%	1272	18%	960	15%
State Programs	400	6%	468	7%	450	7%
RCRA[12]	1070	16%	979	14%	903	14%
Private USTs[13]	1250	19%	1119	16%	823	13%
Private/Non-Regulatory	740	11%	1147	16%	983	15%
Total	**6500**		**6991**		**6465**	

Trends depicted in the above table reflect the evolutionary patterns of demand discussed in Chapter 3: the regulatory-driven portion of the market (Superfund and RCRA) is declining relative to the economic-driven market portion (private/non-regulatory), which has increased.

- **Changing Market Structure** - Markets trends (see table below) reveal a shift from consulting to construction activities. From 1992 to 1994 the percentage of remediation revenues generated from consulting (defined as RI/FS and remedial design) fell from 52% to 38%. Remediation construction, in contrast, grew from 41% in 1992 to 53% in 1994.

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[9] Source: EBJ, Vol. VIII, No. 10, October 1995.

[10] Department of Energy

[11] Department of Defence

[12] Resource Conservation & Recovery Act

[13] Underground storage tanks

TRENDS IN U.S. REMEDIATION MARKET STRUCTURE[14]

Market Segment	1992 $M	% of Mkt.	1993 $M	% of Mkt.	1994 $M	% of Mkt.
Remediation Construction	2665	41%	3363	48%	3456	53%
Site Assessments & RI/FS	2275	35%	1657	24%	1303	20%
Remedial Design	1105	17%	1419	20%	1150	18%
Closure & Monitoring	455	7%	552	8%	557	8%
Total	**6500**		**6991**		**6465**	

- **Competition Intensifying** - Competition in the U.S. remediation business is more intense than it has been in the past. As evidence, the journal cites the results of an industry survey which looked at win rates for government and private sector remediation contracts: win rates[15] for all firms in the government sector were 37% in 1994 and 35% in the private sector, with a total of only 3,739 contracts awarded out of 10,659 proposals bid in the survey set. According to EBJ, most firms would agree that you should win 50% of your bids.

5.2 United States Industry Outlook

Increasing Demand for Business-oriented Services:

Contingent liability reporting (under the Security Exchange Commission), insurance issues and financial ratings have all increased corporations' awareness of remediation problems. In fact, according to the Environmental Business Journal (EBJ, November, 1995), many corporations have set aside tens of millions of dollars for site remediation, but are unsure how to spend these funds most effectively. The journal's author goes on to suggest that this situation will attract more business-oriented service providers to the remediation industry, particularly in the form of accounting and management consulting practices. Again, these are areas of opportunity for remediation firms wishing to either expand their capabilities or team up with qualified partners.

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[14] Source: EBJ, Vol. VIII, No. 10, October 1995.

[15] The term "win rates" refers to the ratio of the number of contracts that are awarded to the number of bids on contracts.

Opportunity for Firms with Remediation Construction Capabilities:

Another positive sign in the U.S. remediation market is the current shift away from remedial investigation (i.e., the identification, through Superfund, of contaminated sites and the means whereby they are to be cleaned-up) toward site cleanup. This shift presents an opportunity for environmental firms with remediation construction capabilities.

DOD and DOE Markets Still Active But Tenuous:

Despite trends indicating that future industry drivers will be predominantly economic-based, significant opportunities still exist in the U.S. regulatory market: for example, refer to trends in the DOD and DOE markets tabled above. Due to federal budget cutbacks, however, these markets are expected to shrink in the near future (Farkas Berkowitz, 1995, pp 8-11).

Uncertainty and Fiscal Constraints Temper Market:

According to EBJ, private sites outside the regulatory scope are seeing some cleanup action, but most are postponing activities pending new regulatory precedents, the outcome of risk analysis and the financial implications of liability reporting. Moreover, the remediation market will be further constrained by declining government budgets which will have a negative impact on Superfund projects as well as on federal enforcement activities

Competition Intensifies:

Competition in all subsegments of the U.S. remediation market has intensified. As a result, the industry is experiencing a trend toward consolidation of firms.

GROWTH PROSPECTS

The relatively robust growth of the U.S. economy in recent years bodes well for the economic-driven portion of the remediation market. Demand for remediation services, however, will be constrained by the issues discussed above: uncertainty and declining government budgets. Consequently, the industry is expected to experience slow growth in the short to medium-term.

Moreover, due to constrained growth and fierce competition, the industry's profit margins can be expected to be slim.

CHAPTER 6

INDUSTRY OUTLOOK & IMPLICATIONS

This chapter begins with a summary of the Ontario remediation industry's SWOT's. This information is then analyzed to determine its implications for the domestic industry's outlook. Finally, a discussion of the implications of the industry's SWOTs and outlook is provided.

6.1 Summary of Industry SWOTs

Strengths:

- "Home-based" industry - i.e., most firms are domestically-owned and operated; hence, there are no corporate barriers to exploiting export opportunities or to developing proprietary technology.

- **High export-orientation** among large firms

- **Highly skilled workforce** with no shortage of skilled labour.

- **Strong industry linkages** - i.e., firms have access to a full range of suppliers and have strong strategic relationships with foreign partners.

- **R&D intensive** - i.e., most companies own proprietary technology and it is estimated that, on average, firms invest 6% of their revenues in R&D.

- **Solid industry infrastructure** - Firms have access to industry associations and universities/research organizations (e.g., firms identified links with universities and Centres of Excellence, notably the Waterloo Centre for Groundwater Research, as important to their competitiveness).

Weaknesses:

- **Low export-orientation among small firms** - a large proportion of the industry's firms are small and lack the critical mass to exploit export opportunities.

- **Low profit margins** - consequently, firms can be expected to experience difficulty in attracting capital for expansion and technology development.

Opportunities:

- **Export opportunities** - The U.S., Eastern Europe and Asia have large markets for remediation services.

- **Government programs and R&D tax credits** are useful to the industry, helping it to develop new technologies.

- **Contamination of urban lands** - Currently, many large industrial facilities containing various degrees of contamination are located on prime urban lands. This is an opportunity for industry growth (Benazon, 1995, pp.12).

- **Remediation construction** - As the U.S. market shifts from remedial investigation to site clean-up, opportunities will emerge for firms with remediation construction capabilities.

- **Niche clean-up technologies** - An opportunity exists for firms to develop and apply technologies for the clean-up of contaminants that can not be disposed of in landfills.

- **Increasing demand for business-oriented services** - Major corporations are recognizing the benefits that accrue from pollution abatement and clean-up. Consequently, they require the services of consultants to advise them regarding the strategic use of corporate resources to address waste reduction and remediation.

- **Increasing demand for project management services** - Firms with this capability will gain a competitive edge, as demand for this type of service is growing.

- **Greater certainty regarding liability** - The MOEE recently released its new site clean-up guidelines, which should provide greater clarity regarding the level of clean-up and liability.

Threats:

- **Real estate** - demand for real estate transfer affects growth in the remediation market.

- **Declining landfill costs** favour landfill disposal relative to the use of remediation technologies.

6.2 Industry Outlook

Strong Fundamentals but Slow Growth:

Ontario remediation firms possess many of the fundamental elements of competitiveness: home-based, R&D intensive, strong linkages and highly skilled workforce. Hence, Ontario's remediation firms, in general, possess attributes that position them to compete in export markets and, accordingly, generate industry growth.

Despite the industry's strengths, its fate is ultimately decided by economic growth in the domestic and international marketplace.

Constraints on Growth of Technology Firms:

The market for remediation technologies, and consequently R&D undertakings, will continue to be affected by the reduction in landfill costs which favours this option relative to remediation technologies. This, in conjunction with the fact that small remediation firms are not highly export-oriented, will impede the growth of small technology firms.

Intensified Competition, Consolidation and Declining Employment:

Constraints on market expansion will lead to intensified competition between domestic rivals. Consequently, future trends in the site remediation industry will include continued competition among environmental service companies and lower remediation costs. This will force further consolidation of vendors, consultants, and contractors into larger corporations offering full service capabilities. Accordingly, employment in the industry is expected to decline.

GROWTH PROSPECTS

It is clear that **export growth is crucial to the future prosperity of the industry.** In fact, large remediation firms consider export markets to provide the best opportunity for growth. Moreover, they expect that penetration of export markets will enable them to grow their businesses in the next five years: many companies have planned for strong corporate growth, in some cases doubling in size in five years.

The industry's export prospects may be limited somewhat, however, given that the U.S. remediation market is also relatively flat.

6.3 Implications for Industry Stakeholders

Remediation Firms

Need for Export Strategies: Remediation firms must develop export strategies, including strategic partnerships which are especially important for small firms that lack economies of scale.

Required Competitive Strengths: Firms with competitive strengths in the provision of environment business-oriented services and remediation construction services will be in a position to capitalize on many opportunities in the U.S. market.

Industry Consolidation: Flat markets and low profit margins are likely to force consolidation within the industry, especially in the case of small firms. This is likely to be exacerbated by the fact that demand for project management services and turnkey services is increasing; small firms do not tend to have these capabilities, as do their larger counterparts.

Challenges to R&D: Competitiveness of technology firms is hampered by conditions favouring landfill disposal which reduces the feasibility of undertaking R&D activity, and by limitations on testing new technologies.

Customers

Low Prices: Due to the fact that the market is both depressed and highly competitive, customers are in a favourable position, as prices are driven down.

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APPENDICES

I Literature Search Terms

II Results: Industry Survey

III Industry Infrastructure

Appendix I

Literature Search Terms

LITERATURE REVIEW SEARCH TERMS			
Services	**Economic Characteristics**	**Equipment/Technologies**	**Intellectual Capabilities**
• Soil Remediation (site decommissioning) • Groundwater Remediation • Remediation Contracting	• sales, revenues • trade, exports, imports, market share • world product mandates • product/service demand • human resources, employment • investment, financial performance, cost competitiveness	• Low temperature thermal desorption • Bioremediation (composting) • Soil vapour extraction • Chelation (metal separation) • Encapsulation • "Pump and treat" • UV (ultraviolet) light treatment • Activated carbon (filtration)	• Consulting • Project management • Process design • Contract administration • Remediation contracting

Appendix II

Results: Industry Survey

Site Remediation Industry

Research Results

March 1996

Work Completed

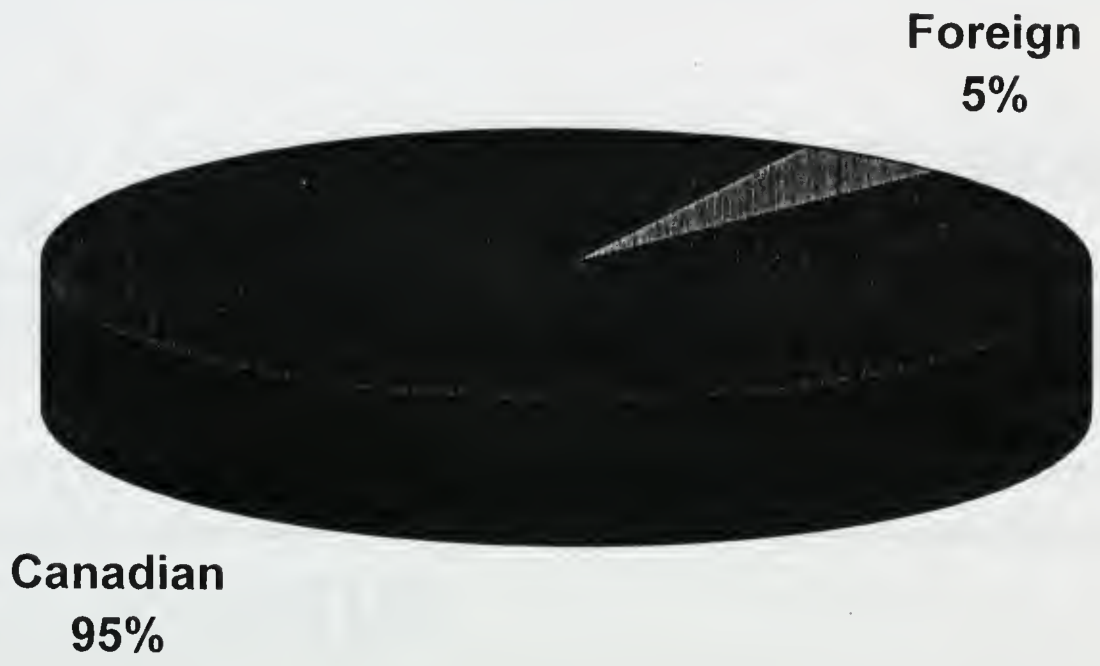
- one page questionnaire faxed to approximately 70 companies; 25 completed surveys
- in-depth interviews with 11 companies in the industry

Survey Results

- Survey results are provided in the following section

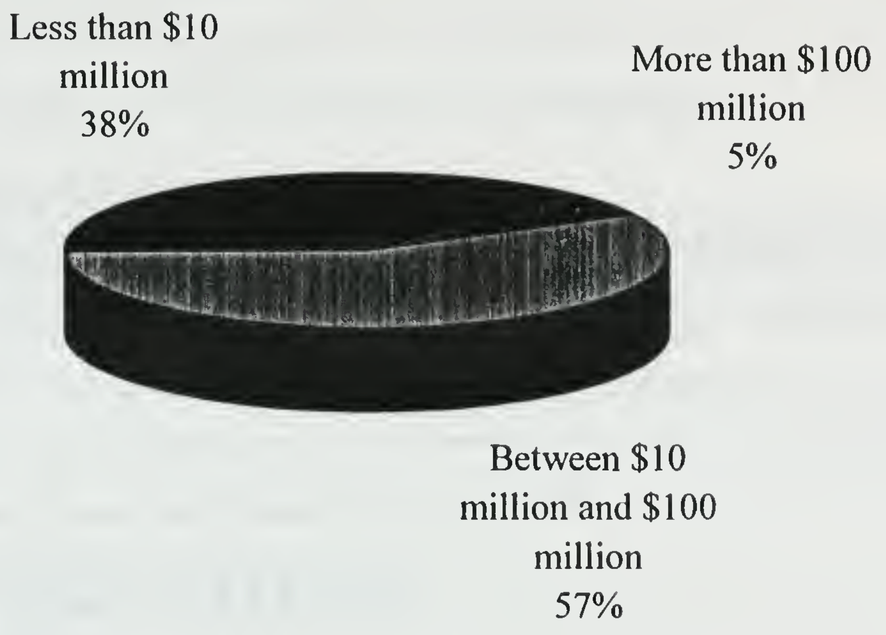
Ownership

- most companies are Canadian owned, private companies
- 88% of companies surveyed were privately owned



Revenues

57% of companies surveyed had revenues between $10 and $100 million; 38% were less than $10 million; 5% of the companies surveyed had revenues more than $100 million



Note: represents companies surveyed, not the industry

Industry Revenues

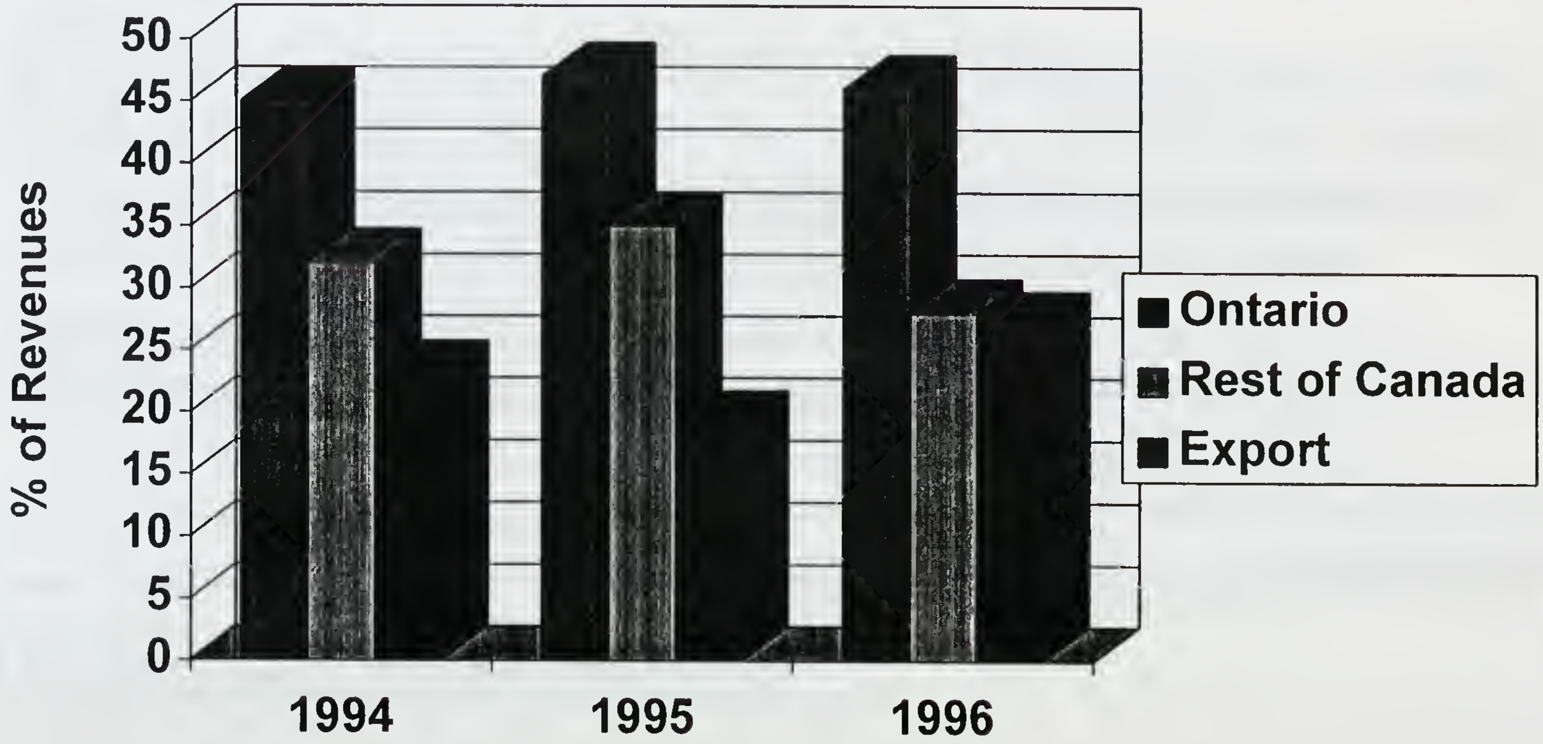
- assuming average revenues per company are approximately the mid-point of each range, then the total revenues of the **companies surveyed** would be about $630 million
- this includes revenue from all sources, all regions
- Total revenues from site remediation activities for the Ontario industry would be in the range of $350 to $400 million (including export revenues)
- Ontario Industry size is estimated at between $200 and $300million (see attached spreadsheets for calculations)
  - based on employment in site remediation from survey results and percentage of revenues earned in Ontario
  - we assumed that the survey represented about 60% of the large companies in the Ontario industry and 30% of the small companies
  - represents revenues generated in Ontario only

Industry Revenues

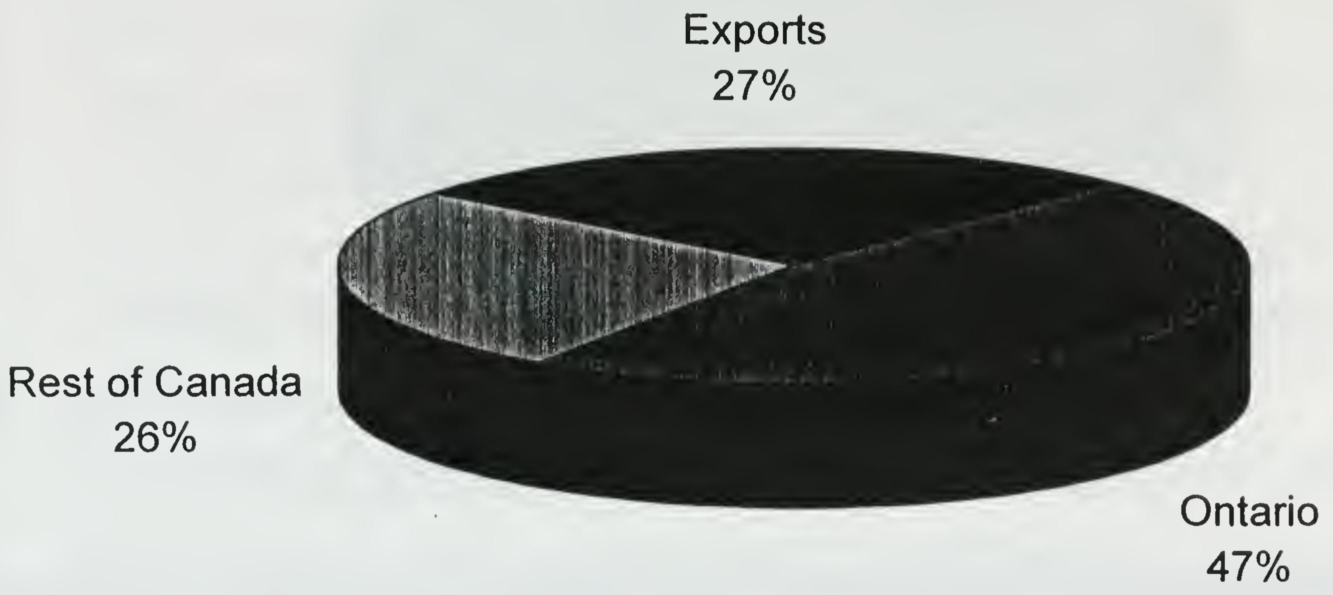
- the difficulty with estimating industry revenues lies in the fact that so much of the revenue is earned in export markets
- for consulting firms, some of this revenue will be generated by Ontario employees, but a substantial amount will be generated by employees who are citizens of the export country
- for technology firms, more of the revenue will be generated by Ontario based employees
- to calculate Ontario revenues, we assumed that employment in Ontario reflects revenue generated in Ontario, although it is more likely that some export revenue is being generated by Ontario employees. Therefore, we would tend to support the high end of the range for revenues generated by the industry in Ontario.

Revenues by Region

- more than half of revenues earned are outside of Ontario

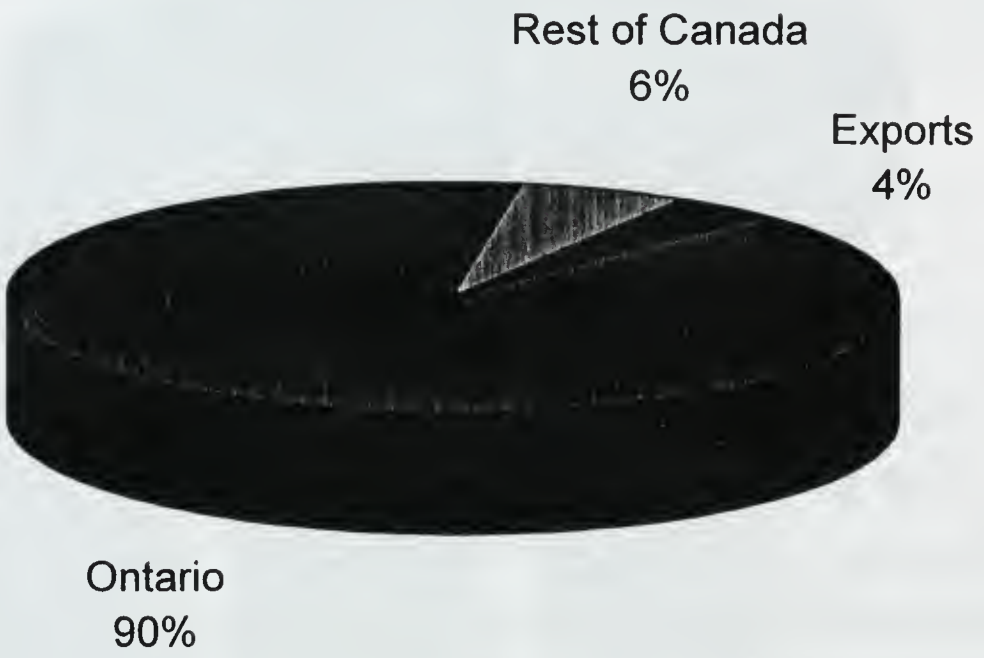


Revenues by Region, Large Cos.



Large companies are those with revenues greater than $10 million

Revenues by Region, Small Cos.



Small companies are those with revenues less than $10 million per year

Employment

- 32% of the employees in the companies surveyed are involved in site remedation activities
  - this is because of the large influence of environmental/engineering consulting firms which engage in a broad range of activities
  - 30% of employees in large firms work in site remediation; 76% of employees in small firms work in site remediation
- environmental consulting firms engaged in site remediation employ large numbers of engineers and technicians/technologists as a percentage of total employment (estimated 70% of employees)
- 60% of firms surveyed employ contract employees, i.e. short term workers hired to work on specific projects or for a duration of less than one year

Employment Size

- companies surveyed employed a total of 3,946 employees (all regions, all activities)
- of these, some 1,177 were employed in site remediation activities, in all regions
- assuming that employment in Ontario is proportionate to the percentage of sales in Ontario, then employment in Ontario, for the companies surveyed, would be equal to 623 workers
- assuming that large companies surveyed represent 60% of the industry and small companies 40%, then employment in Ontario would be about 1,000 to 1,500 employees
- the number might be slightly higher because the ratio of domestic revenues to employment will not be entirely 1:1, i.e. companies with headquarters in Ontario will have additional staff in Ontario

Technology and R&D

- 62% of companies surveyed own proprietary technology
- 71% of companies surveyed invest in research and development activities
- on average firms invest 6% of their revenues in research and development

Interview Results

- Interview Results are discussed under the following headings:
  - Marketing and Distribution
  - Competition
  - Strategic Relationships
  - Human Resources
  - Industry Issues
  - Outlook for the Industry

Marketing and Distribution

- there is considerable diversity in marketing products and services, although most companies interviewed use a variety of channels, i.e. direct sales as well as through other companies
- it is common for small technology companies to market through large engineering firms, especially where they need the project management services of a larger company
- in export markets, many companies market their technology or service through a local partner or distributor

Market Opportunities

- most companies think that the best market opportunities are outside of Ontario
- growing geographical markets mentioned included:
  - Quebec and Alberta, within Canada
  - United States
  - Eastern Europe
  - Southeast Asia
- companies were divided on the issue of technological opportunities with some seeing technology as a driver of new opportunities, and others suggesting that "practical solutions" will be more important in the future

Market Opportunities (con'd)

- some suggested that passive technologies and use of natural remediation methodologies will be more important in the future
- to some extent this reflects a difference in view between companies that are technology focused (example, Eco Logics, Philip/Delsan) and the engineering firms that rely on a combination of methodologies who tend to support the idea that specific and sometimes expensive technologies will not be as important in the future

Competition

- this is a highly diverse and competitive industry; profit margins are low
- most companies interviewed mentioned a number of specific competitors within Ontario; it would appear that there is little competition from outside of Ontario in this market
- consulting firms tend to view other consulting firms as their main competitors
- technology firms view other technology firms as well as dig and dump haulers as their competitors
- consulting firms and technology firms generally see each other as potential partners rather than pure competitors, although there are some exceptions to this rule

Competition

- Strengths of the Ontario Industry include:
  - good perception of Canadian companies in foreign markets as skilled and objective
  - better able to compete against US firms in certain foreign markets, e.g. Russia
  - flexibility
  - consistent service
  - Canadian companies have had to develop more cost effective solutions which, in turn, makes them more competitive abroad
  - proprietary technology and expertise

Strategic Relations

- strategic relations are very important to companies in the industry
- most companies referred to relations with other firms in the industry. Example:
  - technology supplier ⟶ consulting firms
- a few consulting firms identified links with universities and Centres of Excellence, notably the Waterloo Centre for Groundwater Research, as important to their competitive position
- companies also have strategic relationships with foreign partners which are important to export markets

Human Resources

- firms employ a diversity of employees, although most are highly skilled
- a science education is common; specifically scientists, engineers, hydrogeologists (very common)
- project management skills are very important
- also need well drillers, diggers, and equipment operators
- training tends to be company specific, for example, need training to operate a company's technology, or learn the company's own methodologies for remediation
- only one company interviewed mentioned a problem finding skilled employees

Industry Issues

- Regulations
  - concerns about government enforcement of regulations
- Economic Growth
  - the market is driven by economic growth; slow growth in Ontario has tended to reduce market size
- Company Growth
  - many companies have planned for strong corporate growth, in some cases doubling in size in 5 years
  - export growth is important to many companies

Industry Issues

- Technology Development
  - several companies are working on new technologies and perceive that these will be important to their future growth
  - R&D tax credits are useful to the industry, and help it to develop new technologies
  - cancellation of government programs that support R&D has hurt technological development

Outlook for the Industry

- Growth
  - many companies expect that they will be able to grow their business in the next 5 years
  - export markets are considered to provide the best opportunity for growth
  - sales growth in Ontario should be flat, which will likely mean little growth in direct employment in Ontario

Appendix III

Industry Infrastructure

III Industry Infrastructure

Ontario Centre for Environmental Technology Advancement (OCETA)

OCETA is one of three Canadian Environmental Technology Advancement Centres (CETACs), operating as not-for-profit corporations at arm's length from government.

OCETA facilitates the commercialization of environmental technologies by providing an array of services through its Toronto office as well as three "node" offices located in Ottawa, Hamilton, and Kitchener. Affiliated organizations include: Greater Hamilton Technology Enterprise Centre (GHTEC); Toronto Economic Development Corporation (TEDCO); Canadian Environmental Industry Association (Ontario Chapter); University of Waterloo; RockCliff Research Management; ORTECH; Ontario Hydro; Canadian Institute of Technology for the Environment (CITE), and Ottawa-Carlton Economic Development Corporation (OCEDCO).

In its endeavour to help small and medium-size enterprises (SMEs) bridge the gap toward successful commercialization of Canadian technologies, OCETA's services to the environmental industry include: technology assessment and development programs; information and matchmaking services; market assessment, business planning and evaluation; and other assistance with the commercialization process.

Canadian Environment Industry Association (CEIA)

The Ontario chapter of CEIA is a voluntary non-profit business association whose members provide a broad range of environmental products and services. Members are drawn from the following industry sectors: environmental consulting, field services, laboratory services and waste management facilities. Their expertise includes many scientific disciplines, engineering, business management, law and accounting.

The purpose of CEIA and its provincial chapters is to:

- represent and promote the business and professional interests of the Canadian environment industry;
- provide a forum for the exchange of information regarding the environment industry;
- promote research and training in disciplines and matters relevant to the environment industry;
- provide advice to government on environmental regulation and to encourage

action on environmental problems; and

- develop standards to govern the conduct of its members

Waterloo Centre for Groundwater Research

The mandate of the Waterloo Centre for Groundwater Research (WCGR) is to function as a broker between universities, industry, and government to create wealth for Ontario in the areas of protection, remediation, and management of water resources.

WCGR is a separate not-for-profit corporation based at the University of Waterloo, and is one of the seven Centres of Excellence funded by the Ontario Ministry of Economic Development, Trade and Tourism (MEDTT). WCGR focuses on the development and protection of groundwater resources and the implications of waste management on groundwater quality. This is achieved by pursuing a fundamental understanding of the processes that govern the occurrence and quality of groundwater resources. The Centre promotes the development of the Ontario advanced technology groundwater industry while fostering international awareness of Ontario and Canadian groundwater technology and expertise.

WCGR routinely provides advice to municipal, provincial, and federal governmental agencies and the private sector. The Centre also promotes the training of highly qualified groundwater professionals both through formal graduate student education and short courses, conferences, and symposia.

Consulting Engineers of Ontario (CEO)

CEO is an organization devoted to the business and professional aspects of the practice of consulting engineering in Ontario. Its membership of approximately 275 firms includes companies of all sizes, from sole proprietorships to the largest engineering firms in the province.

CEO serves its members through a variety of comprehensive programs that are directed by a full-time secretariat, an active group of committees and a chapter organization. The following list offers a sample of the diverse activities managed by the association:

- To promote the interests of Ontario's consulting engineers, CEO directs a pro-active government affairs program, meeting regularly with Ontario government ministries and Crown agencies.

- Annual meetings are pursued with the Premier of Ontario and key members of his Cabinet to present industry views and to review current legislation and issues.

- CEO publishes a broad spectrum of literature to advise and to promote the industry and its clients.

- CEO offers a comprehensive series of seminars, presenting educators and industry leaders to inform members and to explore topical issues.

- CEO meets regularly with universities, colleges and other educational groups to provide input to curriculum development.

MOEE, Green Industry Office

The mandate of the Green Industry Office (GIO) is to promote the growth of domestic and international markets for Ontario's Green Industry Sector. The GIO assists Green Industry firms in three main areas: technology development, business development and trade promotion. Working closely with the Canadian Environmental Industry Association (CEIA) and the Ontario Centre for Environmental Technology Advancement (OCETA), two of its key private sector partners, the GIO concentrates on activities that help firms gain competitive advantage domestically and abroad. Current objectives of the GIO include promoting strategic green procurement, expanding supplier development, monitoring local venture capital pools, facilitating links for Ontario firms with international funds for projects outside Canada, co-sponsoring workshops on accessing key markets and organizing trade missions of Ontario firms to international target markets.

RELATED MINISTRY OF ENVIRONMENT AND ENERGY PUBLICATIONS

Copies of the following publications may be obtained by contacting the Ministry's Public Information Centre at Tel: (416) 325-4000 or 1-800-565-4923 or Fax: (416) 323-4564:

- Site Remediation Technologies Used in Ontario, January 1996 (PIBS 3398E)
- Treatment Technologies for Contaminated Groundwater (a Literature Review), January 1996 (PIBS 3397E)
- Commercially Available Technologies for Hazardous Waste Treatment, January 1996 (PIBS 3399E)
- MOEE: Guidelines for Use at Contaminated Sites in Ontario, June 1996 (PIBS 3161E01)

Additional information regarding the Ministry of Environment and Energy can be obtained through the Ministry's Internet Web Site: http://www.ene.gov.on.ca

READER RESPONSE FORM

SECTOR ECONOMIC ASSESSMENT ONTARIO ENVIRONMENTAL REMEDIATION SECTOR

March 1997

We value your comments. By completing this form you will help us to increase our understanding of how we can best utilize valuable resources and reduce costs.

1. Did you find the Economic Assessment of value to your business or operation?

2. What part of the report did you find most useful?

3. Are there industry issues and opportunities not identified in the report? If so please identify.

4. Are there areas in the report we can improve?

5. Any other comments you wish to share?

Respondent's name/organization/address/phone number:

Please return a copy of this Reader Response Form by FAX or by mail to the following address:

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Green Industry Office
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5th Floor
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ATTN: Nora Gurland

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ONTARIO'S GREEN INDUSTRY